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Indian Standard

TEXTILE DYESTUFFS — METHOD FOR DETERMINATION OF RELATIVE COLOUR STRENGTH OF DYES IN SOLUTION

ICS 59.020

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1997 **Price Group 2**

Dyestuffs Sectional Committee, TX 17

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Dyestuffs Sectional Committee had been approved by the Textile Division Council.

Determination of colour strength in solution with higher accuracy is useful for control during production of different batches of the same dye. The method for determination of colour strength is based on absorbance measurement of dye solutions. It is usually followed for routine testing and validity of result is ensured by comparison with evaluation by means of an application method.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

TEXTILE DYESTUFFS — METHOD FOR DETERMINATION OF RELATIVE COLOUR STRENGTH OF DYES IN SOLUTION

1 SCOPE

This standard prescribes a method for determination of colour strength of a dye in relation to that of a standard dye by means of spectrophotometric absorption measurements on solutions of dyes.

NOTES

1 Basic requirements for this method are that the dye solutions do not scatter light and obey the Bougher — Lambert — Beer law as well as identical or similar absorption curves of samples and the reference in the visible region of spectrum.

2 Identical or similar absorption curves are usually obtained if the tests are carried out for the purpose of dye production control of batches/deliveries of the same dye. This method is not applicable for the evaluation of dyes with distinctly different absorption curves.

3 The colour strength of a dye is not a physical constant, since it is dependent, for example, on the test medium and test method. The colour strength determined by this method therefore may differ with those found by other determinations that is instrumental or visual assessments of dyeings.

2 REFERENCE

IS 1070 : 1992 'Reagent grade water (*third revision*)' is a necessary adjunct to this standard.

3 TERMINOLOGY

For the purpose of this standard following definitions shall apply.

3.1 Colour Strength

A measure of the ability of a dye to impart colour to other materials. This property is characterised by its absorption in visible region of spectrum and is expressed as a colour strength value.

3.2 Relative Colour Strength

The percentage ratio of the colour strength value of the sample to that of the reference dye, the colour strength of which is 100 percent.

NOTE — As the relative colour strength is determined by comparison with a reference dye, this is assumed to remain constant. It is therefore essential to ensure careful storage and control of reference dye. Many dyes are hygroscopic and sensitive to oxidation. It is essential to protect the reference dye from exposure to light in firmly sealed containers that are impervious to moisture.

3.3 Colour Strength Values

The extinction coefficient at the maximum absorption of the reference dye is designated as colour strength value.

NOTE — Colour strength is traditionally a colouristic concept, being based essentially on a visual assessment. Therefore colour strength determined instrumentally should not contradict visual assessment. Such a contradiction would not be expected if the samples to be compared exhibit concentration-dependent differences in absorption only that is their absorption curves in the visible region are identical when the strength of the absorption curves is made equal, or show only insignificant differences.

If the absorption curves differ more markedly (shade differences), a better correlation with the visual assessment may be obtained if the weighted total extinction in the visible region is used as the colour strength value.

4 PRINCIPLE

Solutions of dye under test and the reference dye are prepared and the absorptivity or colour strength values derived from them are determined. The percentage relative colour strength, Fs, is given by following equation:

$$Fs = \frac{fk_2}{fk_1} \times 100$$

where

fk_1 = colour strength value of reference dye, and

fk_2 = colour strength value of dye under test.

5 APPARATUS

5.1 Flasks

5.2 Pipettes

5.3 Cells

spectrophotometric (optical path length 0.5 cm or 1 cm).

5.4 Analytical Balance

5.5 Spectrophotometer or Filter Colourimeter

6 REAGENTS

6.1 Quality of Reagents

Unless specified otherwise pure chemicals shall be employed in tests. Pure chemicals shall mean chemicals that do not contain impurities which affect the test results.

6.2 Solvents

6.2.1 *For Water Soluble Dyes* — water reagent grade (*see* IS 1070).

6.2.2 *For Water Insoluble Dyes:*

a) Methanol, ethanol;
b) Acetone;
c) N-Methylpyrrolidone ;
d) Dimethyl formamide;
e) Cellosolve, ethylene glycol monoethyl ether; and
f) Mixtures of the above solvents.

Dilute the concentrated stock solution (*see* **7.1.3** and **7.1.4**) with the same solvents. Dissolve the stock dispersion in organic solvents and then dilute. The following additives are recommended to improve the stability and reproducibility :

a) to adjust the *p*H:
   acids (for example, sulphuric acid, acetic acid);
   bases (for example, sodium hyodroxide, sodium carbonate); and
   buffer systems.
b) to eliminate the influence of unwanted metal ions :
   sequestering agents.
c) agents with a deagglomerating or disaggregating action in water :
   surfactants, generally ethylene oxide adducts to alkanols.
d) other additives :
   dispersing agents, and
   antioxidants.

7 PROCEDURE

7.1 Preparation of Solutions for Measurement

7.1.1 *Samples*

It is necessary to ensure that samples are representative. The samples are stored in firmly sealed containers in order to avoid erroneous results arising from the release or uptake of moisture.

7.1.2 *Weighing*

The weigh not less than 0.5 g of sample due to, thereby avoiding errors attributable to micro-inhomogeneities to the nearest 0.000 5 g. It is essential to ensure that uptake of moisture by hygroscopic dye samples does not lead to errors during weighing.

7.1.3 *Dissolving/Dispersing*

The weighed dye is transferred to a graduated flask and dissolved/dispersed. As a rule, pre-dissolving/dispersing in about 20 ml of the dissolving/dispersing medium or an additional solvent or auxiliary is advantageous Water soluble dyes are preferably dissolved hot. It is essential to ensure that the solubility limit is not exceeded during subsequent cooling. After equilibrating the solution to ambient temperature (20°C to 25°C), the graduated flasks are made up to the mark and the solution/ dispersion is homogenized by shaking or stirring.

7.1.4 *Dilution*

The solution/dispersion prepared according to **7.1.3** is diluted or dissolved so that the maximum extinction value lies whithin the range of 0.5-1.5. To avoid errors, of dilution no pipette of total volume less than 5 ml nor graduated flask less than 100 ml should be used. For commercial dyes the corresponding concentrations for measurement are within the range of 10 mg/l to 100 mg/l for 1 cm cell path length or proportionately more for shorter path length cells.

7.2 Measurement and Evaluation

7.2.1 Carry out the measurement as soon as possible after preparation of solution, in order to exclude the influence of changes in solution.

NOTE — When a dye is measured for the first time it is advisable to confirm the validity of the relationship (Beer's law) under the conditions selected (solvent, concentration) within a range of concentrations between one-half and twice that actually used.

Appropriate techniques of handling (darkened flasks, working in dimly lit surroundings) should be adopted with light sensitive solutions.

7.2.2 *Measurement*

The absorbance of the solution is measured in cells of identical path length (normally 0.5 cm or 1 cm). In order to minimize the influence of variations in the spectrophotometric response over a relatively wide range of concentrations, the difference in absorbance between the sample and the reference dye should not exceed 30 percent. Depending on the measuring instrument used, the absorbance, A, of the dye solution is obtained directly as a measured result (double-beam spectrophotometer with simultaneous measurement of an identical cell filled with the solvent used for dilution, or a single-beam instrument previously calibrated with a cell containing solvent), or is calculated as the difference between the absorbance of the dye solution, A_R, and a blank value A_B (measurement of the solvent)

$$A = A_R - A_B$$

7.2.3 *Evaluation of Relationship*

The evaluation is based on Beer's law using the following equations:

$$A = \log_{10}(1/t) = \varepsilon cd$$

where

A = absorbance;

t = transmittance (decimal fractions, 0 to 1.0) (per unit mass), cm^2/g;

ε = specific extinction coefficient (per unit mass), cm^2/g;

c = dye concentration, g/cm^3; and

d = cell path length, cm.

7.2.4 *Relative Colour Strength*

The relative colour strength is given by the following equation:

$$Fs = \frac{\varepsilon_2}{\varepsilon_1} \times 100$$

or by substituting from the above equation :

$$Fs = \frac{A_2 C_1}{A_1 C_2} \times 100$$

where

Subscript 1 refers to the reference dye, and

Subscript 2 refers to the dye under test.

If the measured concentrations are equal, the following simplified equations is obtained :

$$Fs = \frac{A_2}{A_1} \times 100$$

8 TEST REPORT

The test report shall contain the following details:

a) Date;

b) Type and designation of the sample and the reference dye; and

c) Relative colour strength.

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